Quercus prinus - 46

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Chestnut oak (Quercus prinus L.) is also called tanbark oak, rock oak, and rock chestnut oak (15). The last two names probably originated from its frequent occurrence in rocky places. The present species name is a restoration from montana, following Fernald, to the earlier name of prinus. Sudworth's check list (23) and most dendrology texts still list prinus as the species' name for swamp chestnut oak.

RANGE

Chestnut oak is of rather limited distribution compared with the other eastern oaks. In brief it is found in relatively pure stands on the slopes of the Appalachian Mountains and in the closely surrounding territory (fig. 1). Elsewhere over its range it usually occurs in small groups or individually. It reaches maximum size and quality on mountain slopes in the Carolinas and Tennessee (20).

USES

Until 1900, 85 percent of the chestnut oak cut was for its bark alone, which was used in the production of tannin. At the present time, however, it is much more valuable as a source of lumber. Betts (2) ranks it third among the oaks in volume of standing timber, and in a recent survey (17) it ranked first among all species in western North Carolina. In addition to its use as lumber, it is also extensively utilized for crossties. The lack of tyloses prohibits its use as cooperage stock.

HABITAT CONDITIONS

CLIMATIC

The climate within the natural range of chestnut oak is humid. Average annual precipitation varies from 35 to 55 inches, generally well distributed throughout the year. Seasonal temperatures vary from a low of -20° F. in the north and at the higher altitudes to a high of about 100° in the south and at the lower elevations (28).

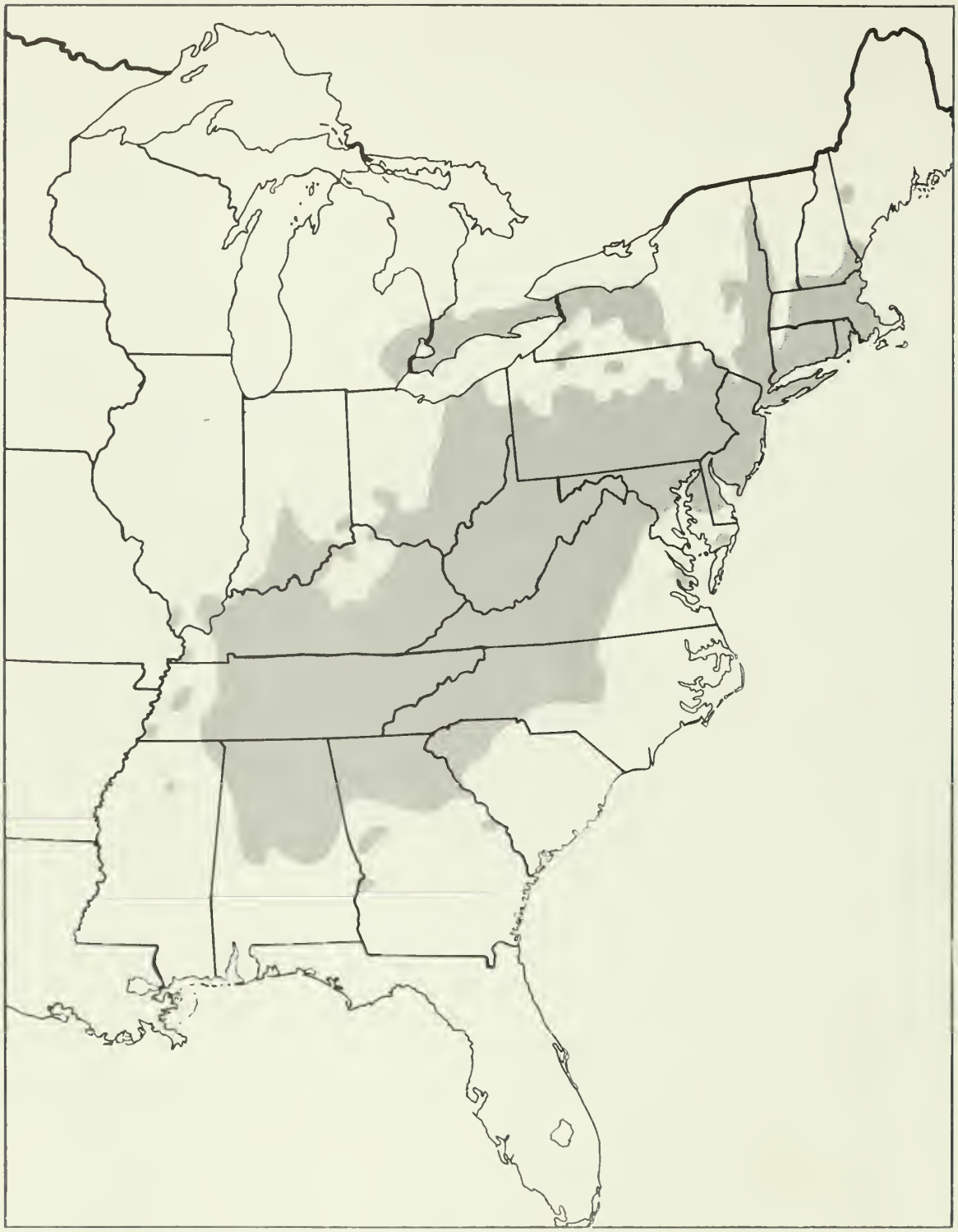


Figure 1.--Botanical range of chestnut oak.

EDAPHIC AND PHYSIOGRAPHIC

This species is found on a rather wide variety of soils within its range. It does better than most other species of oak on dry, sandy, or gravelly soils, but reaches maximum development in the rich, well-drained coves and bottoms. It grows on soils that vary from the gray-brown podzolic in the north to the red and yellow podzolic soils in the southern part of its range (25).

In the south the upper limit for the chestnut oak is at an elevation of about 4,500 feet above sea level, and its lower limit is 1,000 feet. Elsewhere over its range the species grows at elevations of less than one hundred feet. Extremes of heat and cold seem to have little effect on chestnut oak, and temperature alone is probably not a limiting factor in its distribution.

BIOTIC

Chestnut oak is a component of 11 of the 106 cover types listed for North America (22). It is a major species in two: chestnut oak (No. 44) and white pine-chestnut oak (No. 51). In the chestnut oak type it is pure or predominant, and the common associates are scarlet oak (Quercus coccinea), black oak (Quercus velutina), white oak (Quercus alba), pitch pine (Pinus rigida), blackgum (Nyssa sylvatica), sweetgum (Liquidambar styraciflua), and red maple (Acer rubrum).

Pure stands of chestnut oak are often found on dry rocky ridges. When chestnut oak occurs with eastern white pine (Pinus strobus), the associated species on the drier sites are scarlet oak, blackgum, red maple, flowering dogwood (Cornus florida), hickory (Carya sp.), pitch pine, Table-Mountain pine (Pinus pungens), Virginia pine (Pinus virginiana), post oak (Quercus stellata), and shortleaf pine (Pinus echinata). In the cove sites its associates are yellow-poplar (Liriodendron tulipifera), northern red oak (Quercus rubra), white oak, black cherry (Prunus serotina), black walnut (Juglans nigra), white ash (Fraxinus americana), and red maple.

Shrubs found with chestnut oak include the highbush blueberry (Vaccinium corymbosum), lowbush blueberry (Vaccinium angustifolium), dwarf chinquapin oak (Quercus prinoides), and mountain-laurel (Kalmia latifolia).

The chestnut oak acorn (fig. 2), because of its large size and sweet taste, is a favorite food of the white-tailed deer (Odocoileus virginianus) and the gray squirrel (Sciurus carolinensis). Because the nut is so large, only an occasional acorn is eaten by birds and then by only the larger ones, such as the turkey (Meleagris gallopavo) (13).

Figure 2.--Typical bark, twig and bud, fruit, and leaves of chestnut oak.

LIFE HISTORY

SEEDING HABITS

The flowering season of chestnut oak begins in early April in the Southern Appalachians and extends into May in the northern states. Wright (30) found that heavy flowering does not necessarily indicate heavy fruiting. Unfavorable weather, such as a hard freeze, may have an adverse effect.

Although chestnut oak flowers along with the other oaks, it is the first to drop its seed, according to Downs (6). There are conflicting reports on the frequency of good seed crops. One source states that good seed crops occur about once in 4 to 7 years in the Southern Appalachians (6), whereas another indicates that a good crop is produced every other year (27). A third source shows that chestnut oak is an irregular seeder, producing two good crops in 5 years (29). More studies are probably needed to determine the cycle.

Downs (6) found that acorn production increased with tree size--up to 26 inches d.b.h. In his study, well-developed acorns averaged 42 percent sound, and the percentage of sound acorns increased with larger crops.

Two authorities have reported that weevil damage in the Appalachians was more severe during years of light crops (6, 13). However, even weeviling does not necessarily preclude germination of the acorn (1). It has been found that three groups of insects are responsible for acorn damage (13): nut weevils (Curculio spp.), moth larvae (Valentinia glandulella), and gall-forming cynipids (Cynipidae). Moth larvae are occasionally abundant enough to do considerable damage to the acorn crop (4).

VEGETATIVE REPRODUCTION

A high proportion of chestnut oak reproduction is of sprout origin, and it is estimated that 75 percent of the chestnut oak reproduction in the Southern Appalachians originated from sprouts (7). Frothingham (8) states: "Among the oaks, chestnut oak is the most prolific and persistent sprouter." In common with associated oaks, sprouting is very successful when stumps are small, but decreasingly so as the size and age of the stump increases (16).

According to Roth and Sleeth (19), decay of chestnut oak sprouts in the larger stump sizes is serious. Even so, they found that chestnut oak had the lowest percentage (11 percent) of decayed sprouts of all oak species. Once decay has been transmitted from the stump to the sprout, rot may weaken the tree to a point where it falls easy prey to a high wind.

SEEDLING DEVELOPMENT

Chestnut oak seeds germinate soon after falling if conditions are favorable (fig. 3). In the Central States, Barrett found that litter depth is the most important single factor positively correlated with germination and early sur-

Figure 3.--Two-month old chestnut oak seedling; stem approximately 4 inches long.

vival (1). A minimum litter depth of 1 inch and a maximum of 2 inches appeared best for both germination and early survival. It was also found that shade had a slightly favorable effect on germination. Fall seeding without stratification is the recommended nursery practice (27).

Because oaks probably represent the climax vegetation stage, they are capable of growing in all-age stands. Downs (6) reported that partial cutting in the Southern Appalachians provides more favorable conditions for germination than seed-tree cutting. He recommends a 2-cut shelterwood method, with the first cut providing for germination and the second for growth.

Kuenzel and McGuire (14) clearly indicated that a reduction of 50 percent of the original basal area failed to provide as good survival or growth conditions as clear cutting following establishment of a good crop of seedlings in the Central States. Total height growth of seedlings 10 years after establishment averaged 0.5 foot on the uncut area, 0.8 foot on the released area, and 4.8 feet on a clear-cut area. Sprout growth on the clear-cut area was even better, averaging over 21 feet.

Squirrels, chipmunks (Tamias striatus), and mice (Peromyscus sp.) are commonly regarded as the most important consumers of acorns, but in a study at the Bent Creek Experimental Forest, near Asheville, N. C., deer were regarded as more important than rodents (6). In the past, frequent and severe ground fires in the late fall and early spring have reduced the stocking of oak seedlings and sprouts which otherwise might have produced adequate stands.

SAPLING STAGE TO MATURITY

Chestnut oak is a medium-size tree normally maturing at 60 to 80 feet in height and 20 to 30 inches d.b.h., depending on site (2). Maximum size is 100 feet tall and up to 6 feet in diameter (10).

As with most of the white oak group, growth is slow (fig. 4). Furthermore, because the species so often grows on poor sites, physiological maturity comes at a relatively late age. Trimble's West Virginia study (24) showed that chestnut oak has a site index ratio of 0.98, compared with northern red oak at 1.00, and white oak at 0.95 on the same site. In all vigor classes, Campbell (5) found chestnut oak growing faster in the Southern Appalachians than American beech (Fagus grandifolia), the hickories, or yellow birch (Betula alleghaniensis), but slower than the red oaks, American ash, red maple, or sugar maple (Acer saccharum). McIntyre's study (18) of oak radial growth rates in Pennsylvania proved that chestnut oak was the slowest growing of the five oaks studied. Perhaps the discrepancy between the West Virginia and the Pennsylvania growth findings could be explained by the fact that the West Virginia study is based on height growth, whereas the Pennsylvania study is based on radial growth.

Chestnut oak responds well to thinning; this is especially true of sprout clumps of the U-type, which should usually be thinned to a single sprout.

Sawtimber yields of pure chestnut oak stands on the better dry slopes and ridges of the Southern Appalachians amount to 7,000 board feet at 80 years of age, according to Frothingham (8). He also estimated annual growth at 90 board feet per acre during the 10-year period between stand age 70 and 80 years. Maximum periodic growth for the typical chestnut oak site is reached at about 100 years of age and is estimated at 100 board feet per acre per year (8). Yields in cords for the same site and age are estimated at 38 cords total and a periodic growth rate of $\frac{1}{2}$ cord per acre per year.

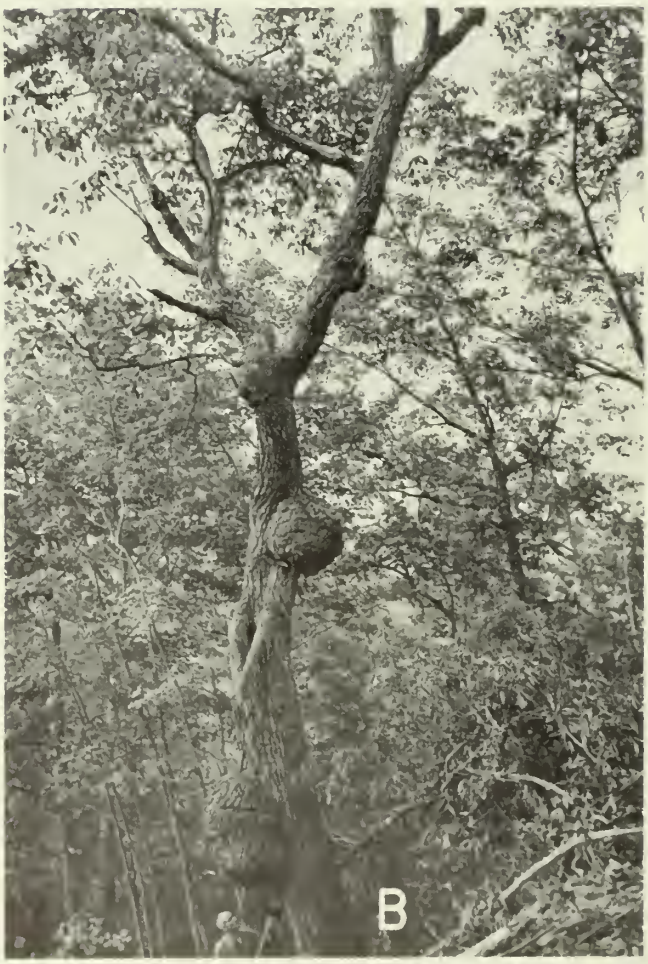
Chestnut oak in the mountain region of western North Carolina contributes one-eighth of the total volume of all sawtimber--more than any other single species (17). It is believed that this same proportion would hold true for many other areas of the Southern Appalachians.

Economic maturity, based on lumber values and average growth rates, on average to good sites ranges from 21 to 25 inches d.b.h. (5). The larger diameter applies to trees found on the better sites and those with good vigor. On poor sites it is doubtful if the trees will ever reach these sizes.

Principal Enemies

One of the few species that will grow on dry sites and ridges where burning is frequent and sometimes intense, chestnut oak suffers considerable fire damage. If fire doesn't kill the tree outright, it slows the growth and usually results in butt rot. This in turn results in both volume and quality losses.

Figure 4.--A, forest-grown mature chestnut oak, Buncombe County, N. C. This tree is 29 inches d.b.h., 87 feet tall, and nearly 250 years old. B, Defective chestnut oaks of low quality are not uncommon, especially on poor sites.



Chestnut oak is subject to oak wilt (Ceratocystis fagacearum) but, being a white oak, it is less susceptible than most of the red oak group (26). It is also susceptible to a conspicuous twig blight caused by Dipladia longisporia. Boyce (3) lists the common oak decay fungi as the sulphur fungus (Polyporus sulphureus), (Polyporus spraguei), hedgehog fungus (Hydnum erinaceus) and string rot (Armillaria mellea). Strumella coryneoidea and Nectria sp. are serious oak cankers in some localities, especially from Virginia northward (11). Chestnut oak is one of the oaks most resistant to typical heart and sapwood decays (21). Nevertheless, in old and frequently burned stands it is usually a very defective tree.

Chestnut oak is relatively resistant to most insect borer attacks, but the species is quite susceptible to the pin or shot hole type of beetle. In eastern Kentucky, chestnut oak logs were found least infested with borers of all oaks studied (9); however, because of heavy damage by shot hole insects, the total volume loss of chestnut oak from both shot and bore holes was greater than for any other oaks--amounting to 46 percent.

Among the most destructive pin or shot hole insects in chestnut oak are the ambrosia beetles, of which the Columbian timber beetle (Corthylus columbianus) is well known for boring in otherwise sound wood. Members of two other ambrosia beetle genera (Platypus and Xyleborus) are also important, but usually they are not serious until the trees are weakened by fire or drought (12). The oak timberworm (Arrhenodes minuta), though not an ambrosia beetle, is a common insect that enters the tree through wounds and produces tiny pin holes in the wood sometimes rendering the tree useless (12).

Two very important borers in chestnut oak are the carpenter worms (Prionoxystus robiniae and Prionoxystus macmurtrei) which tunnel in all directions in both the heartwood and sapwood of trees. The holes, often as large in diameter as one's finger, may extend for several feet.

Among the important defoliators are the spring and fall cankerworm (Paleacrita vernata and Alsophila pometaria) and the forest tent caterpillar (Malacosoma disstria). June beetles (Phyllophaga spp.) are sometimes important defoliators along with species of Datana. The gypsy moth (Porthetria dispar) is an important oak defoliator in parts of the northeast.

Gall insects and the pit-making oak scale often cause the death of branches and occasionally may cause the death of entire trees.

SPECIAL FEATURES

The bark of chestnut oak contains about 12 percent tannin (10), and the production of sole leather tannin from the bark was an important use until 1950, even for low grade trees. Synthetic sole leather substitutes have now largely taken over.

RACES AND HYBRIDS

No races of chestnut oak are known. Sargent (20) reports chestnut oak crossing with Quercus robur to form the hybrid Quercus x sargentii Rehd., but Little (15) says this cross occurs only under cultivation. Little also reports the following crosses: Quercus x bernardiensis (Quercus prinus x stellata) and Quercus x saulii (Quercus alba x prinus) (fig. 5).

Figure 5.--Natural hybrid of chestnut oak, Quercus alba X prinus to form Q. X saulii. Tree located near Carnesville, Georgia.

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